A METHOD AND AN ARRANGEMENT IN A MOBILE RADIO SYSTEM

TECHNICAL FIELD OF THE INVENTION

The invention relates to a mobile LAN and a method in a mobile LAN.

A local area network, LAN is generally understood to be a set of computer hosts, interconnected by a transmission medium, enabling communication between the different hosts. A mobile LAN is, in the context of this application, a LAN where hosts connected to the LAN may communicate with hosts, connected to networks remote from the LAN, via routing means and a mobile station operating in a mobile radio system.

DESCRIPTION OF RELATED ART

Mobile LANs are useful not only in truly mobile applications, such as trains or buses. They are also useful when a LAN is set up temporarily, such as on trade fairs or athletics games. On these occasions it is often difficult to use the fixed telephone network and therefore a mobile LAN is a competitive alternative.

A mobile LAN involves a number of hosts. In many applications this number is relatively low, 5-10 hosts is considered a normal number. However, mobile LANs with a substantially larger number of hosts are also possible.

The hosts are interconnected by a transmission medium, such as for instance a coaxial cable and they communicate with each other by using a predetermined communication protocol. Hosts on the LAN may receive data packets from and transmit data packets to hosts connected to networks remote from the mobile LAN via routing means and a mobile station operating in a mobile radio system. These packets may, for instance,

be transmitted over the Internet where the TCP/IP protocol suite is used.

An important issue when dealing with routing of packet data over clusters of networks, such as the Internet, is how to provide necessary addressing features. For a packet to reach its proper destination, this destination needs a unique address which is referred to as a network layer address. This address is included in all data packets having this destination and, therefore, all routers in the network will pass on incoming packets in an appropriate direction. One part of this address is preferably associated with the network in which the host resides and another part is preferably an identifier for the particular host in the network.

Therefore, a host that is attached to a mobile LAN must be provided with a globally defined network layer address, such as an IP address as regards the Internet, in order to perform a communication with a host attached to a network remote from the mobile LAN. A globally defined address is unique in the cluster of networks where it is used.

One feasible method to provide hosts on a mobile LAN with network layer addresses is to retrieve such an address from the mobile radio system, in which the mobile station associated with the mobile LAN operates. Such a method may be derived from US 5708655, which is incorporated herein by reference. When a host in such a system requests a network layer address this request is transmitted to the mobile radio system by the mobile station connected to the host. Then the mobile radio system retrieves a network layer address from a pool of available addresses in the system or from an Internet Service Provider associated with the mobile radio system. An Internet Address Server is updated so that data packets bearing the retrieved address are routed towards the appropriate mobile station. Then the network

layer address is communicated to the host in question and packet data communication may commence over a packet data channel between the mobile station and the mobile radio system in which it operates.

For a host that is being attached to a mobile LAN it is a rather complicated and time consuming procedure to retrieve a network layer address from the mobile radio system where the mobile station, connected to the mobile LAN, operates. Thus there will be a substantial delay before a host on the LAN, requesting to perform a packet data communication with an external host, will be able to perform such a communication. Moreover, if network layer addresses are to be allocated and deallocated frequently over the air interface of the system these operations will add load to the system, particularly from increased control traffic.

SUMMARY OF THE INVENTION

One object of the present invention is to achieve a mobile LAN of the initially mentioned kind, where hosts that are attached to the LAN may perform packet data communications with hosts attached to external networks in an efficient way.

Another object of the invention is to provide a mobile LAN that can initialise a packet data communication between a host connected to the LAN and a host attached to an external network, via routing means and a mobile station connected to the LAN and operating in a mobile radio system, with reduced load on this system during the initialisation.

These objects are achieved, according to one aspect of the invention, in a mobile LAN of the initially mentioned kind where a set of locally defined network layer addresses are used internally in the LAN. Locally defined addresses are unique in the network where they are used, and packets with these addresses cannot be transferred to other networks. A

number of unique, globally defined network layer addresses are stored in storing means, connected to the routing means. When a host on the LAN wishes to perform a packet data communication with a host on an external network, the internally defined address assigned to this host is temporarily translated into one of the globally defined addresses stored in the storing means.

The result of these measures is that a host attached to a mobile LAN can begin a packet data session without performing any initialisation process over the air interface between the mobile station associated with the LAN and the mobile radio system in which it operates. Therefore, a packet data communication can be initiated faster and more efficiently and the mobile radio system need not be unnecessarily loaded by this initialisation.

The translation procedure may be completely transparent to the host on the LAN. When such a host attempts to perform a packet data communication with an external host the translation is performed automatically. Therefore a host on the LAN may act as if its locally defined address actually was globally defined.

In a preferred embodiment the above mentioned translation means are designed to change a destination address field of data packets moving into the mobile LAN from the globally defined address into the locally defined address. This procedure is adapted to the TCP/IP protocol suite.

In another preferred embodiment the above mentioned translation means are designed to change a source address field of data packets moving out of the mobile LAN from the locally defined address into the globally defined address. This procedure is adapted to the TCP/IP protocol suite.

In yet another preferred embodiment the above mentioned routing, address translating and storing means are

integrated in the mobile station associated with the mobile LAN. This provides a robust unit and makes the preparation of a mobile LAN quicker.

In yet another preferred embodiment the number of globally defined addresses stored in the storing means is one. This provides with reduced complexity in soft- and hardware employed in the storing and address translating means. Nevertheless, external connectivity for a number of hosts is maintained, since those hosts may share the single address. If communication with external hosts is performed only occasionally the risk of more than one host on a LAN wishing to perform such a communication at a given time is rather low.

A mobile LAN according to the invention is then characterised as it appears from the characterising part of the appended claim 1. The above mentioned embodiments are characterised as it appears from claims 2-5 respectively.

In another aspect of the invention, the above mentioned objects are achieved by a method for establishing a packet data communication between a host among a first number of interconnected hosts and a host connected to an external network, utilising globally defined addresses. The data packets of the communication are routed, radio transmitted over an air interface and sent over the external network. A set of locally defined and internally used addresses is used for data packets to be communicated by the host among the first number of hosts. A number of globally defined addresses of the kind used in the external network are stored and one of the internally used addresses is temporarily translated into one of these globally defined addresses.

In a preferred embodiment of a method according to the invention, the temporary translation of a locally defined

address assigned to a host is terminated when this host has not transmitted nor received any data packet for a predetermined time. This method allows the global addresses in the storing means to be efficiently used.

A method according to the invention is then characterised as it appears from the characterising part of the appended claims 6 and 7. The above mentioned embodiments of the invention are characterised as it appears from claims 8-10 respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates generally a mobile LAN connected via a cellular radio system according to prior art.

Figure 2 shows a mobile LAN according to the invention connected via a cellular radio system.

Figure 3 shows the structure of a data packet.

Figure 4 illustrates examples of transmissions of packet data according the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Figure 1 illustrates a mobile LAN 101 included into a cellular radio system. A number of hosts, e.g. computers 1021-1024, are interconnected by a transmission medium 103 and may communicate with each other via this medium. Routing means 104, such as a router, is connected to or included in the LAN and routes packet data to and from the LAN. The routing means may also route packet data between hosts on the LAN. A mobile station 105, capable of performing packet data transmission, is connected to the routing means 104 and operates in a mobile radio system.

The mobile radio system in this embodiment is a cellular public land mobile network. This network consists of a

number of cells 111, each defining a geographical area. At least one base station 112 operates in each cell, performing communication with mobile stations in this cell over the air interface. Each base station is connected to a Mobile Services Switching Centre, MSC 113. In some systems, such as the GSM system, a base station controller BSC (not shown) is connected between the base station and the MSC. A number of base stations are then connected to each BSC and a number of BSCs are associated with each MSC. There may be numerous MSCs in a public land mobile network. The MSC performs switching operations for all mobile stations residing in its cells. A MSC is normally provided with a gateway, GMSC 114 for switching voice traffic from mobile stations to fixed telephones 115 via the public service telephone network, PSTN 116.

A Packet Mobile Services switching centre PMSC 120 is connected to the MSC 113. As an alternative a PMSC may be connected directly to a base station (not shown). In some embodiments a PMSC may be integrated into a MSC.

A PMSC 120 is provided with a gateway for packet data traffic, GPMSC 117. A GPMSC may have a direct connection to the Internet 118, or it may alternatively be connected to an Internet Service Provider, ISP (not shown), performing Internet related functions for the PLMN. The Internet in the context of this application may be any cluster of local and wide area networks utilising unique network layer addresses.

Via the GPMSC 117, data packet communication may be performed between a host 1024 attached to the mobile LAN 101 and a host 119, remote from the LAN and connected to the internet, given that both hosts are assigned unique network layer addresses. As earlier described a network layer address may be dynamically assigned to a host on the mobile LAN from the mobile network, in this case the PLMN or an ISP associated to the PLMN. This, however, requires that the

network layer address is requested and distributed over the air interface, which has drawbacks as mentioned above.

Figure 2 shows a mobile LAN 201 according to the invention included into a cellular radio system. This LAN also comprises a number of hosts, e.g. computers 2021, 2022, 2023, 2024, interconnected by a transmission medium 203, such as a coaxial cable or an optical fibre, routing means 204 and a mobile station 205 as earlier described. The PLMN is identical with the PLMN, described in figure 1 and comprises cells 211, base stations 212 MSCs 213 and PMSC 220 with the gateways GMSC 214 and GPMSC 217. As earlier described these gateways provide connections to fixed telephones 215 via the PSTN 216, as well as packet data connections to remote hosts 219 via the Internet 218.

In order to render the packet data communication features of the mobile LAN more effective, storing means 206 for storing a number of globally defined network layer addresses is connected to the routing means 204. Furthermore, address-translating means 207 is connected to the routing means 204.

The hosts 2021- 2024 on the LAN are assigned locally defined network layer addresses that are used within the LAN. If a first host 2024 on the LAN requests to perform packet data communication with a remote host, e.g. a host 219 connected to the Internet, the translating means 207 will temporarily translate the locally defined address of the first host 2024 into one of the globally defined addresses stored in the storing means 206. Thereby, this globally defined address is temporarily assigned to the host 2024. This translation appears to be transparent to the host 2024 on the LAN; the globally defined address need not be communicated to the first host 2024. The translation procedure will be given a more detailed description below.

In a preferred embodiment the routing means 204, the storing means 206 and the translating means 207 are integrated in the mobile station 205. This provides a robust unit, which enables quick preparation of a mobile LAN.

When a host on the LAN which has been assigned a globally defined network layer address, has not received nor transmitted any packet data via the address translator 207 for a predetermined time, the assignment of the globally defined address is withdrawn and this address may be reused by any host 2021- 2024 on the LAN.

The globally defined network layer addresses stored in the storing means 206 may be placed at disposal in different ways. As one alternative these addresses are permanently assigned to a subscription connected to the mobile station, i.e. a certain identification unit such as a SIM-card used in the mobile station. In this case no further preparations need be made when a mobile-LAN is prepared. The PLMN knows already how to route data packets to the LAN if it knows where the mobile station associated with this subscription resides.

Another alternative is to assign a set of globally defined network layer addresses when the mobile LAN is initially set up. Then these addresses are retrieved from the PLMN or an ISP associated with the PLMN. This requires, as earlier described, initialisation procedures over the air interface, but in this case this procedure need only be performed once.

If the number of addresses in the storing means 206 is only one, then the software and the hardware in the storing and address translating means 206, 207, respectively may be substantially simplified. This allows low-cost units to be produced.

Figure 3 shows the structure of a data packet 300 as sent from a host 2021- 2024 in the LAN or from a remote host 219

in the global network 218. The packet consists of a header part 301 and a user data part 302. The header part 301 involves fields of information 303- 307 needed for the transmission of the packet 300 to be completed. The user data part 302 includes the information to be transmitted.

The source address field 303 contains the network layer address of the host that the packet was sent from and the destination address field 304 contains the network layer address where the packet is to be sent. The sequence number field 305 contains the sequence number of the packet and is required since packets not always arrive in the same order they were sent. The acknowledge sequence number field 306 is used to acknowledge that a data packet has reached its destination. The header part 301 also includes a number of miscellaneous and control fields 307. These are used, among other things, to verify that a packet has been transmitted uncorrupted.

The earlier mentioned translation procedure, performed in the address translator preferably consists in changing the source address field 303 of a data packet, moving out of the mobile LAN, from the locally defined address assigned to the host into the globally defined address temporarily assigned to the host. When a data packet moves into the LAN the translation procedure consists in changing the destination address field 304 of the packet from the globally defined address temporarily assigned to the host into the locally defined address assigned to the host. These procedures are preferably software implemented.

Some of the miscellaneous and control fields 308 may be dependent upon the address fields that are changed. Therefore, when changing an address field, any field depending thereupon should be changed accordingly. Otherwise the receiving side of the communication may find, incorrectly, that the packet received has been corrupted.

Address translators have been described when used in large corporate networks, see IETF, RFC 1597 (Rekhter, Moskowitz, Karrenberg, de Groot) and 1631 (Egevang, Francis), which are included herein by reference. Therefore, procedures for adjusting control fields as mentioned above are known in the art.

Figure 4 illustrates examples of transmissions of packet data according the invention. A number of hosts 4021, 4022, 4023, 4024 are interconnected by a transmission medium 403 and form, together with routing means 404 and a mobile station 405, a mobile LAN. The mobile station 405 operates in a mobile radio system 406, which is connected to the Internet 409. Memory means 407 for storing a number of globally defined network layer addresses and address translation means 408 are connected to the routing means 404.

A first host 4024 is assigned a locally defined network layer address 10.210.55.19. The globally defined network layer address 96.113.45.7, stored in the storing means 407, has been temporarily assigned to the first host.

A data packet 421a is transmitted from this first host to a second host 4010 remote from the first host and connected to the Internet 409. The second host has the network layer address 136.12.22.84. Before the data packet 421a passes the address translating means 408 the destination address is 136.12.22.84 and the source address is 10.210.55.19. When the same packet, now named 421b, has passed the address translating means 408 the destination address is 136.12.22.84 and the source address is 96.113.45.7. The source address is changed by the address translating means 408 and the destination address is unchanged.

When a data packet 422a is sent in the opposite direction the destination address, before the packet 422a reaches the

address translating means 408, is 96.113.45.7. The source address is 136.12.22.84. When the packet, now named 422b, has passed the address translating means 408 the destination address is 10.210.55.19 and the source address are 136.12.22.84. In this case the destination address has been changed by the address translating means 408, while the source address is unchanged.

The storing means 407 and the address translating means 408 are preferably integrated as one unit and may be software implemented as a translation table. In a preferred embodiment this software is integrated with the software of the routing means 404.

The above-described embodiments serve only as examples of how the invention may be carried out, and do not by any means limit the scope of protection sought. Various other embodiments are possible. For instance, the invention is not limited for use in public land mobile networks such as the GSM system. The use of mobile LANs operating via satellite communications systems is one possible embodiment, which is useful, for instance, when a mobile LAN is installed in a long distance aeroplane. The invention may also be realised using other protocols than TCP/IP. For instance, the UDP/IP protocol not utilising sequencing and acknowledging, may be used. Another possibility is the protocols following IPv6, which allow a substantially larger number of globally defined network layer addresses to be used.